

Remarks

The examiner's reconsideration of the application is requested in view of the amendments above, attachment hereto, and comments which follow.

Taking the matters raised by the examiner in turn, the non-elected claims have been deleted. There were only claim 1 through 15 in the application, not 1 through 18 (there was an amendment during the international phase, and it is with those amended claims that the Patent and Trademark Office begins its review), and therefore the new claims in this application have been properly identified as claims 16 and 17.

In numbered section 3 of the office action, the examiner requires a new title and requires the Abstract on a separate sheet. Both are accomplished by this response, as will be seen.

Beginning in numbered section 4 at the bottom of page 3 of the office action, the examiner enters rejections of the claims as either being anticipated by, or obvious over, Song U.S. Patent Number 5,695,385 and, in relation to obviousness, in view of Stansbury U.S. Patent Number 5,634,585. Reconsideration is requested.

A fundamental difference between the present invention and Song is that, whereas the present invention is concerned with providing methods of manufacture of field emitting devices in a low-cost manner, Song is not concerned with this at all. The teaching of Song is summarised on Col 1, lines 45 to 48 as follows:

Thus, there exists a need for a method for fabricating field emission devices, employing field emissive films, which prevents the formation of defects within the dielectric layer and reduces row-to-column current leakage.

The disclosure in Song is entirely consistent with this objective.

Thus, it comes as no surprise to find that, in Song, the disclosed manner of manufacture is in no way a low-cost option that is as applicable to large devices as to small ones. The methods disclosed in Song concentrate on realizing his stated objective, and invariably involve the use of expensive semiconductor-type processing equipment in high-grade clean rooms. This is the kind of manufacturing methods that the present invention seeks to avoid.

For example, if one considers Figs 10 to 15 of Song, together with Col 3, line 57 to col 5, line 39 as cited by the Examiner, one can see from col 4 lines 64-65 that the thickness of the dielectric layer 341 is about 1 micron. It is well known to those skilled in the art that, if a dielectric layer such as 341 is about 1 micron thick, then the emitter well diameter must be of a comparable size – see, for example, the present specification, page 10, lines 28-29. Typically, the well diameter may be about twice dielectric thickness, i.e. ~2microns. The skilled reader will know very well that all processes on structures with such dimensions must be performed using expensive semiconductor-type processing equipment in high-grade clean rooms. This clearly goes against Applicants' teaching.

With reference to Song's Fig 14, the small discs 370 of emitter surface (~2 microns diameter) are buried under many layers, with layer 351 being optically opaque. To realise Song's structure, a photoresist mask must be formed on the surface of the gate conductor 351 with the many (millions in a real device) apertures in accurate registration (~0.1 micron) with the already formed emitter discs 370. This is not a process that can be carried out across large area substrates as envisaged by Applicants, without catastrophic run-out errors developing.

So in Song, we have a series of high resolution steps required, from the very small patterning of hardmask 368 in Figure 10 to form the very small discs 370 of emitter surface, to final patterning for a single etch operation, to arrive at the final emission wells 360 of Figure 15. The degree of registration required between this series of high resolution steps will be immense.

In fact, Song never even considers or mentions whether his steps are low resolution or high resolution. There is absolutely no teaching in this regard. Song doesn't even illustrate or explain the final masking and etching step as between Figs 14 and 15. It is of no interest to him. Song's attention is focussed firmly upon forming the smooth continuous surfaces 371. But as discussed above, one can see that Song must have a plurality of high-resolution steps.

In contrast to this, Applicants' method provides the opportunity to have just a single high-resolution step, with much lower registration requirements. The cathode and gate "tracks" and intermediate layers are firstly formed by low-resolution means. Then, just a single high-resolution exposure can define the cells, which are then etched by a sequential etching process. The tolerance of the positioning of the high-resolution exposure can be relatively low, since it has no other high-resolution formation to register with.

It is important to note that Song does not disclose or suggest a sequential etching process as required in step (e) of claim 1. As already noted, Song provides no illustration or explanation of the final masking and etching step as between Figs 14 and 15. He just says that the emission well 360 is formed by selectively etching portions of the various layers, and leaves it at that.

Applicants specifically require in claim 1 that the etching of the layers 305, 304 and 303 is sequential. This means that layer 305 is etched first, and then layer 304, and finally layer 303. Thus, as is clearly described in the specification, the layer 305, after it has been etched, serves as a mask for etching the layer 304 and, while the layer 304 is being etched, the layer 303 below it serves as an etch-stop to protect the field emitter layer 302. Once etched, the layer 304 serves as a mask for the final etching of the layer 303, which finally exposes the field emitter layer 302, which is not affected by the etchant for the layer 303.

A sequential etching step is nowhere disclosed or suggested in Song. There is no reason to modify Song to provide such a sequential etching step. The teaching and objective of Song is in an entirely different direction.

To emphasize the difference from Song, Applicants' claim 1 has been amended to define the layer 303 as an "etch-stop layer", and its purpose defined as "protecting said field emitting layer (302) from etchant during etching of said insulating layer (304)".

Thus, it is submitted that claim 1 is both novel and non-obvious over Song and all other known prior art.

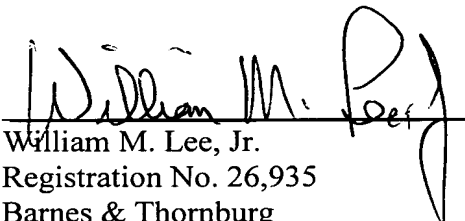
Since claim 1 is both novel and non-obvious, dependent claims will likewise be novel and non-obvious. Accordingly, it is believed that detailed comment on the remaining two references, which are not directed at claim 1, is not required.

An appropriate petition for extension of time is submitted herewith.

Given the above, further and favorable reconsideration of the application is urged.

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Respectfully submitted,



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